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Behavioural responses of the Indian gerbil, *Tatera indica* to conspecific sebum odour of the ventral scent marking gland

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Abstract. Behavioural responses of the Indian gerbil, *Tatera indica*, to conspecific sebum odour of the male ventral marking scent gland were studied in a glass cage and a plus maze. Male and female gerbils were attracted towards the strange male sebum odour though its magnitude was low in females possessing the ventral marking gland, still lower in the females in which the marking gland was absent. The diversity in preferential behaviour of female *Tatera indica* is discussed in relation to the role of ventral marking behaviour in chemical communication among rodents. Correlating the results of the experiments with our field observations, it appears that the function of scent marking in *T. indica* is more of a 'familiarisation' nature to label the habitat for its own use in orientation or to signal 'home' to the marking animal.

Keywords. Chemical communication; familiarisation; gerbil; homing; phagostimulant; scent marking; *Tatera indica*.

1. Introduction

The Indian gerbil, *Tatera indica*, a Turanian element (Prakash 1974), is distributed throughout the Indian sub-continent. The sub-species *T. i. indica* is one of the predominant rodents found in the desert region, occupying almost all the habitat types (Prakash 1975). Whereas a number of gerbil families inhabit a single burrow in the village complex or around an urban area, they live individually or in pairs in open desert grasslands. These two distinct types of *Tatera* populations exhibit a difference in the intensity of occurrence of the mid-ventral scent marking gland in females. In the former population in which social organisation is intense, 5% adult females possess it whereas in the scattered populations it is present in 12% of the females. However the gland occurs in about 89% adult males in both the types of populations. The difference in the frequency of occurrence of scent-marking gland in female *Tatera* existing in two types of social organisation is being reported for the first time among rodents and it makes the functional role of this gland in chemical communication more intricate as well as interesting. The results of our experiments to investigate the behavioural

responses of male and female Indian gerbil, *Tatera indica indica* towards the sebum (secretion of the ventral marking scent gland) odour are presented in this communication.

2. Methods

All the gerbils, *T. i. indica* were collected from the sandy habitat around Jodhpur 26° 18′ N, 73° 01′ E). The first experiment was conducted in a glass cage (90 × 30 × 30 cm). 60 gerbils (30 ♂, Avg. body weight 129·53 ± 5·1 g and 30 ♀, 110·4 ± 4·5 g) were individually released in the cage one by one and were oriented for 6 days and then exposed to sebum odour of a strange male. Before releasing the next gerbil, the cage was thoroughly washed and dried. One glass slide smeared with the sebum of a strange male was placed on one side of the cage and another clean slide on the other side, following Kumari and Prakash (1981a), to avoid new object reaction (Mathur and Prakash 1980). The experimental gerbil was released in the middle of the cage and its behaviour (sniffing, licking, urination, defecation, ventral marking) in relation to the individual stimulus on both the sides of the cage was observed for 30 min. The number of visits and duration of every behavioural act in the vicinity of the two slides were recorded with the help of a stop watch. Observations were made at night under infra-red light at the maximum activity epoch of the gerbils.

In the second experiment, the behavioural responses of *T. indica* were observed in a residential plus maze (Bhardwaj and Prakash 1981), both by ocular observations and by recording the relative food consumption. 10 male (Av. body weight 120·7 ± 8·2 g) and 10 female (96·0 ± 7·9 g) were released one by one in the plus maze and were acclimatized for 6 days in the new environment. Thereafter, the gerbils were provided weighed quantity of pearl millet (*Pennisetum typhoides*) in arms A and C, drinking water in arm D. The arm B remained empty. 24-hour consumption of millet in both the food baskets was recorded for 6 days. Whereafter, a slide carrying sebum smear of a strange male (*T. indica*) was placed in the arm in which food consumption was lower (A), and a blank slide in the other arm (C) near the food container. Food consumption was again recorded in both the arms for 4 days. Rodents were released in the central chamber of the plus maze and were free to move and explore any of the arms. A complete record of their visits and duration to every arm was maintained for 15 min soon after the introduction of the two slides.

3. Results

A comparison of the mean number of visits by gerbils to the sebum odour slide and clean slide in the glass cage indicates that the frequency of visits to each section was similar but the duration of visits was significantly more in the side in which the sebum odour slide was lodged (students t, $P < 0{\cdot}001$, Bailey 1959, table 1). Male as well as female gerbils were attracted towards the sebum odour of strange male though its magnitude was lower among females as indicated by their behavioural responses (table 2).

Table 1. Olfactory response of *Tatera indica* to conspecific male sebum odour.

	Stimulus	No. of visits per 30 min Mean ± SE	Duration of response (seconds) Mean ± SE
Male	Male sebum	27·10±1·85	17·60±0·87***
	Blank slide	27·16±1·87	12·41±0·64
Female	Male sebum	31·13±1·93	16·70±0·38***
	Blank slide	30·90±1·91	13·72±0·50

Level of significance (Student's t test, Bailey 1959).
*** = $P < 0·001$.

Male as well as female (possessing the ventral marking scent gland) *T. indica* sniffed ($P < 0·001$), urinated ($P < 0·05$) significantly more times (table 2) in presence of another male's sebum odour. Male gerbils significantly ventral marked ($P < 0·001$) and licked ($P < 0·05$) more in the cage side carrying the odour stimulus. No difference was, however, observed in grooming behaviour. The females, however, did not differ in their response to strange male sebum odour in respect of various social acts (table 2).

In the plus maze, after the sebum smeared slide was placed near the food basket in the arm (A) in which consumption of plain pearl millet was significantly ($P < 0·001$) lower than in arm C (table 3), the food consumption by both male and female *Tatera indica* in the former increased significantly ($P < 0·001$). However, in case of males, in the presence of the two set of slides (columns 3 and 4, table 3) millet intake by male gerbils declined significantly ($P < 0·05$) in arm C but in case of females this difference was not statistically significant which indicates that the attraction towards strange male sebum by the females is of lower intensity as compared to that by males.

Both male and female *T. indica* indicated a similar behavioural pattern, as in the glass cage, by showing an increased frequency of sniffing and licking ($P < 0·01$) in the section of sebum smeared slide (figure 1). The frequency of ventral marking activity by males also exhibited an enhanced rate ($P < 0·01$) towards the sebum slide but the females did not ventral mark at all because these were the females which had no ventral scent marking gland (figure 1). A similar pattern of the duration of various social acts was also observed.

4. Discussion

The ventral scent marking gland is present in both the sexes in the genus *Meriones* (Sokolov and Skurat 1966 ; Kumari *et al* 1981) but in the genus *Tatera* in which the occurrence of such a gland was reported earlier (Prakash and Kumari 1979), it is present in 89% males and only in a few females. Results of our experiments

Table 2. Mean number and duration (seconds) ± SE of behavioural acts by *Tatera indica* per 30 min in presence of conspecific male sebum odour and blank slide.

Sex	Stimuli	Sniffing		Licking		Ventral marking		Grooming		Urination	Defecation
		N	*D*	*N*	*D*	*N*	*D*	*N*	*D*	*N*	*N*
Male	Sebum smear	2·5*** ±0·34	10·1*** ±1·61	1·63* ±0·33	7·70** ±1·79	4·00*** ±0·64	6·68** ±0·64	2·03^{NS} ±0·29	59·83^{NS} ±5·87	1·46** ±0·23	1·43^{NS} ±0·20
	Blank slide	1·30 ±0·22	5·42 ±1·04	0·84 ±0·21	3·20 ±0·82	1·96 ±0·40	4·01 ±0·51	2·00 ±0·46	33·43 ±7·88	0·86 ±0·09	0·86 ±0·23
Female	Sebum smear	2·53** ±0·40	11·00*** ±1·79	1·13^{NS} ±0·28	6·73^{NS} ±1·75	1·30^{NS} ±0·38	2·15^{NS} ±0·64	1·36^{NS} ±0·27	21·26^{NS} ±3·25	1·03** ±0·20	1·23^{NS} ±0·27
	Blank slide	1·30 ±0·36	4·75 ±0·96	0·70 ±0·18	3·50 ±1·20	0·76 ±0·35	1·38 ±0·60	0·96 ±0·24	23·73 ±7·63	0·43 ±0·12	0·96 ±0·20

N = Number of act, D = Duration in seconds
Level of significance NS = Not significant * = $P < 0.05$, ** = $P < 0.01$, *** = $P < 0.001$.

Table 3. Food consumption by *Tatera indica* in absence and presence of conspecific male sebum odour.

Sex	Mean food consumption g/100 g body weight ± SE			
	Arm A (without any stimulus)	Arm C	Arm A (with sebum odour slide)	Arm C (with plain slide)
	1	2	3	4
Male	1·68±0·37	3·25±0·38	3·58±0·45	2·46±0·37
Female	1·80±0·31	3·75±0·42	3·90±0·36	3·28±0·42

Level of significance between
1 and 3 male < 0·001
1 and 3 female < 0·001
2 and 4 male Not significant
2 and 4 female Not significant
3 and 4 male < 0·05
3 and 4 female Not significant.

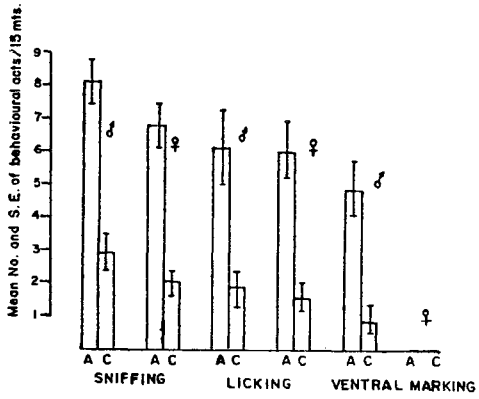

Figure 1. Frequency of various behavioural acts by male and female (not possessing the ventral scent-marking gland) *T. indica* in the two arms of plus maze, one carrying strange male sebum odour (*A*) and the other without it (*C*).

clearly indicate that all the three categories of *T. indica* (males possessing scent marking gland), females possessing the gland (experiment 1 in glass cage) and females without them (experiment 2 in plus maze) are attracted towards the sebum odour of strange male suggesting that it has a bio-chemical communication function in this genus. However, the frequency and duration of social acts by male and female *T. indica* clearly indicate that the magnitude of attraction towards strange male odour is much lower among females as compared to males. In this preferential behaviour *T. indica* is similar to *Meriones tristrami* (Thiessen *et al* 1973)

and *M. unguiculatus* (Thiessen *et al* 1970). Indian desert gerbil, *M. hurrianae* prefers the gland odour of similar sex given the choice of odour of both sexes. However, in the absence of the same sex odour, both male and female are attracted towards opposite sex odour (Kumari and Prakash 1981a). In this behaviour the females of *T. indica* differ from *M. hurrianae* though they occur in similar habitats in the Indian desert and are the two most predominant rodent species of the region.

We have already reported that if the food is impregnated with sebum odour it functions as phago-stimulant in *T. indica* (Kumari and Prakash 1979). This observation is further confirmed by the results of experiment 2 in as much as that even when the experimental females were those which did not possess the scent gland, their food consumption increased significantly ($P < 0{\cdot}001$) in the presence of the sebum odour (table 3).

Another interesting observation made is about the significant ($P < 0{\cdot}001$; table 2) enhancement of ventral marking activity by male and females (possessing the scent-marking gland) in the presence of the sebum odour of a strange male. In the plus maze experiments, similar enhancement ($P < 0{\cdot}01$) in marking behaviour of males was observed but this social behaviour in females was entirely absent. These were the females in which the scent gland was absent and as such the social act of ventral marking was not expected. What is interesting is that even in the absence of the gland they were attracted towards male sebum odour (table 2). The variance in the ventral marking behaviour of the two groups of females but the similarity of their being attracted towards strange male sebum odour complicate the functional role of ventral scent-marking gland.

A number of workers have explained the functions of ventral scent marking among rodents. Ewer (1968) stated that an animal's own scent might act to "increase its confidence" in the environment, whereas Eibl-Eibesfeldt (1953) and Mykytowycz (1968) conjecture that scent marks provide "homeliness" to the animals. Other functions designated to scent marking are territorial (Thiessen 1973), individual identification (Daly 1977), recognition of pups (Wallace *et al* 1973), phago-stimulant (Kumari and Prakash 1979), food reservation (Kumari and Prakash 1981a) and "advertising ready to mate" stage by estrous females (Kumari and Prakash 1981b). On the basis of limited observations on *T. indica* it is rather difficult to delineate the exact function of ventral marking and the role of sebum odour. However, our observations (unpublished) in a large enclosure, the Rattery, under infra-red light show that *T. indica* ventral mark their burrow openings quite often, more so before entering a burrow opening. It was also noted that scent marking is carried out at an enhanced frequency by the chasing *Tatera*, soon after the chased one enters a burrow. *Tatera* also mark the food containers, the grass clumps and any new object whether it is a stone or a wooden peg. From these observations, it appears that the function of scent marking in *T. indica* is more of a "familiarisation" nature, or to signal 'home' to the marking animal or that of labelling the habitat for an animal's own use in orientation (Johnson 1973). Whether it plays any territorial role is not clear. Besides, these animals perform an anal drag behaviour and leave a slightly moist surface, they possibly mark with urine or with a pheromone contained in it. It is now known that the urine of *Tatera indica* has a phago-stimulant property

(Kumari and Prakash, unpublished data). These odours may leave sufficient olfactory cues which might deter other conspecifics away from the occupied territory. Our observations suggest that marking behaviour can have a number of functions and more intensive work, which is in progress, may reveal the secrecy of scent marking in rodents and its role in the bio-chemical communication.

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